

Transactions  
of  
American Society  
for Metals

---

Volume XXIII  
January — December, 1935

Ray T. Bayless  
*Editor*



Published and Copyrighted by  
American Society for Metals  
7016 Euclid Ave.  
Cleveland

## Table of Contents

Alloys of Iron and Chromium—By V. N. Krivobok.....	1
Studies on the Metallurgy of Arc Deposited Weld Metal—By Samuel L. Hoyt...	61
Discussion .....	85
Nonmetallic Inclusions in Steel—By Stephen F. Urban and John Chipman.....	93
Discussion .....	110
The Effect of Deoxidation on Some Properties of Steel—By C. H. Herty, Jr....	113
Discussion .....	121
The Metastability of Cementite—By H. A. Schwartz.....	126
Discussion .....	151
Heat Treatment in Controlled Atmospheres Including Gaseous Carburizing— By C. R. Austin .....	157
Discussion .....	184
Oxidation of a Low Carbon Steel in the Temperature Range 1650 to 2100 Degrees Fahr.—By Clarence A. Siebert and Clair Upthegrove.....	187
Discussion .....	216
The Ductility of Chromium-Nickel Austenitic Steels at Elevated Temperatures —By H. D. Newell .....	225
Discussion .....	243
The Cobalt-Molybdenum System—By W. P. Sykes and Howard F. Graff.....	249
Discussion .....	283
Properties of Some Cast Alloy Steels—By T. N. Armstrong.....	286
Discussion .....	311

E. Eng. Soc.

Ed. Dept.

Transactions  
of  
American Society  
for Metals

Volume XXIII  
January, 1935 — December, 1935

Ray T. Bayless  
*Editor*



Published by  
American Society for Metals  
7016 Euclid Ave.  
Cleveland

Copyrighted, 1935, by the  
American Society for Metals  
Cleveland, Ohio

Printed in U. S. A.

# Contents

## MARCH

Alloys of Iron and Chromium— <i>V. N. Krivobok</i> .....	1
Studies on the Metallurgy of Arc Deposited Weld Metal— <i>Samuel L. Hoyt</i> .....	61
Discussion .....	85
Nonmetallic Inclusions in Steel— <i>Stephen F. Urban and John Chipman</i> ...	93
Discussion .....	110
The Effect of Deoxidation on Some Properties of Steel— <i>C. H. Hertys, Jr.</i> .....	113
Discussion .....	121
The Metastability of Cementite— <i>H. A. Schwartz</i> .....	126
Discussion .....	151
Heat Treatment in Controlled Atmospheres Including Gaseous Car- burizing— <i>C. R. Austin</i> .....	157
Discussion .....	184
Oxidation of a Low Carbon Steel in the Temperature Range 1650 to 2100 Degrees Fahr.— <i>Clarence A. Siebert and Clair Upthegrove</i> .....	187
Discussion .....	216
The Ductility of Chromium-Nickel Austenitic Steels at Elevated Tem- peratures— <i>H. D. Newell</i> .....	225
Discussion .....	243
The Cobalt-Molybdenum System— <i>W. P. Sykes and Howard F. Graff</i> ...	249
Discussion .....	283
Properties of Some Cast Alloy Steels— <i>T. N. Armstrong</i> .....	286
Discussion .....	311

## JUNE

Physical Properties of Case Hardened Steels— <i>O. W. McMullan</i> .....	319
Discussion .....	380
The Influence of Nonmetallic Inclusions Upon the Precipitation of Pri- mary Cementite in Hypereutectoid Steels— <i>E. G. Mahin and E. F. Lee</i> .....	382
Discussion .....	395
Directional Properties in Rolled and Annealed Low Carbon Steel— <i>Arthur Phillips and H. H. Dunkle</i> .....	398
Discussion .....	405

Malleable Castings— <i>Albert Sauveur and Harry L. Anthony</i> .....	409
Discussion .....	422
A Graphical Method of Calculating Heat Loss Through Furnace Walls— <i>Clarence E. Weinland</i> .....	431
Discussion .....	444
Thermal Expansion Characteristics of Some Nickel Cast Irons— <i>T. J. Wood</i> .....	455
Practical Observations of Some High Carbon High Chromium Tool Steels— <i>W. H. Wills</i> .....	469
Discussion .....	486
Prolonged Tempering at 100 Degrees Cent. and Aging at Room Temper- ature of 0.8 Per Cent Carbon Steel— <i>G. A. Ellinger and R. L. Sanford</i> .....	495
Discussion .....	507
New Development in Electrical Strip Steels Characterized by Fine Grain Structure Approaching the Properties of a Single Crystal— <i>N. P. Goss</i> .....	511
Discussion .....	531
Relation of Chemical Composition to the Rail Fissure Problem— <i>Earnshaw Cook</i> .....	545
Magnetic Properties of Iron as Affected by Carbon, Oxygen and Grain- Size— <i>T. D. Yensen and N. A. Ziegler</i> .....	556
Discussion .....	574

## SEPTEMBER

The Influence of Oxide Films on the Wear of Steels— <i>Samuel J. Rosenberg and Louis Jordan</i> .....	577
Discussion .....	598
X-Ray Exposure Charts for Steel— <i>Herbert R. Isenburger</i> .....	614
Discussion .....	618
Grain Distortion in Metals During Heat Treatment— <i>C. Nusbaum and N. P. Goss</i> .....	621
Discussion .....	631
The Effect of High Hydrostatic Pressures on Aging— <i>Leland Russell van Wert</i> .....	633
Discussion .....	643
Nonmetallic Inclusions in Steel—Part II— <i>Stephen F. Urban and John Chipman</i> .....	645
Retained Austenite and Its Decomposition Range in a Quenched Cobalt High Speed Steel— <i>C. A. Liedholm</i> .....	672

A Comparison of the Corrosion Resistance of Several Wrought Irons Made by Different Processes— <i>O. A. Knight and J. R. Benner</i> .....	693
Discussion .....	700
Cutting Temperatures Developed by Single-Point Turning Tools— <i>O. W. Boston and W. W. Gilbert</i> .....	703
Discussion .....	723
Alloys of Iron and Manganese—Part XIII— <i>F. M. Walters, Jr., and Cyril Wells</i> .....	727
Discussion .....	746
Alloys of Iron, Manganese and Carbon—Part XIV— <i>Cyril Wells and F. M. Walters, Jr.</i> .....	751
Impact Resistance of Certain Nickel Steels at Low Atmospheric Temperatures— <i>D. A. Campbell</i> .....	761
Effect of Grain-Size Upon Some Physical Properties of Medium Carbon Steels— <i>F. G. Seifing and K. J. Trigger</i> .....	782

#### DECEMBER

The Importance of Aluminum Additions in Modern Commercial Steels— <i>Harry W. McQuaid</i> .....	797
Hardening Characteristics of One Per Cent Carbon Tool Steels— <i>T. G. Digges and Louis Jordan</i> .....	839
Discussion .....	856
Interpretation of Torsion Impact Properties of Carbon Tool Steel— <i>G. V. Luerssen and O. V. Greene</i> .....	861
Discussion .....	878
Contributory Effects of Furnace Atmospheres on the Grain-Size of Molybdenum High Speed Steel— <i>Arthur Phillips and M. J. Weldon</i> .....	886
Discussion .....	905
Correlation of Failures from Embrittlement of 4 to 6 Per Cent Chromium Steel with the Notched Bar Impact Test— <i>H. M. Wilten</i> .....	915
Discussion .....	939
Chromium Steels of High Nitrogen Content— <i>Russell Franks</i> .....	968
Discussion .....	987
Influence of Carbon Content on High Temperature Properties of Steels— <i>A. E. White, C. L. Clark and R. L. Wilson</i> .....	995
Discussion .....	1015
A New Heat Resistant Alloy— <i>S. L. Hoyt and M. A. Scheil</i> .....	1022
Discussion .....	1039
The Aging of Steel— <i>E. S. Davenport and E. C. Bain</i> .....	1047
Discussion .....	1096
The Orientation of Crystals in Silicon Iron— <i>Richard M. Bozorth</i> .....	1107
Technical Program, 17th Convention, Chicago .....	1112
Annual Address of President .....	1115
Report of Treasurer .....	1120
Annual Report of Secretary .....	1123



# AMERICAN SOCIETY *for* METALS

## Officers and Trustees

R. S. ARCHER, President Republic Steel Corp., Chicago	E. C. BAIN, Vice-President U. S. Steel Corp., New York City
W. P. WOODSIDE, Treasurer Climax Molybdenum Corp., Detroit	W. H. EISENMAN, Secretary 7016 Euclid Ave., Cleveland

## TRUSTEES

B. F. SHEPHERD, Past President  
Ingersoll-Rand Co., Phillipsburg, N. J.

G. B. WATERHOUSE  
Massachusetts Institute of Technology  
Boston

S. C. SPALDING  
American Brass Co.  
Waterbury, Conn.

WALTER MATHESIUŠ  
Carnegie-Illinois Steel Corp.  
Chicago

R. L. KENYON  
American Rolling Mill Co.  
Middletown, Ohio

---

## PAST PRESIDENTS

ALBERT E. WHITE .....	1921
FRANK P. GILLIGAN .....	1922
*TILLMAN D. LYNCH .....	1923
*GEORGE K. BURGESS .....	1924
WILLIAM S. BIDDLE .....	1925
ROBERT M. BIRD .....	1926
J. FLETCHER HARPER .....	1927
FREDERICK G. HUGHES .....	1928
ZAY JEFFRIES .....	1929
R. G. GUTHRIE .....	1930
J. M. WATSON .....	1931
A. H. d'ARCAMBAL .....	1932
WILLIAM B. COLEMAN .....	1933
WILLIAM H. PHILLIPS .....	1934
B. F. SHEPHERD .....	1935

---

\*Deceased



# INDEX OF AUTHORS

## VOLUME XXIII

### TRANSACTIONS OF AMERICAN SOCIETY FOR METALS

January, 1935—December, 1935

A		M	
Anthony, Harry L. ....	409	McMullan, O. W. ....	319
Armstrong, T. N. ....	286	McQuaid, Harry W. ....	797
Austin, C. R. ....	157	Mahin, E. G. ....	382
B		N	
Bain, E. C. ....	1047	Newell, H. D. ....	225
Benner, J. R. ....	693	Nusbaum, C. ....	621
Boston, O. W. ....	703		
Bozorth, Richard M. ....	1107	P	
C		Phillips, Arthur ....	398, 886
Campbell, D. A. ....	761	R	
Chipman, John ....	93, 645	Rosenberg, Samuel J. ....	577
Clark, C. L. ....	995	S	
Cook, Earnshaw ....	545	Sanford, R. L. ....	495
D		Sauveur, Albert ....	409
Davenport, E. S. ....	1047	Scheil, M. A. ....	1022
Digges, T. G. ....	839	Schwartz, H. A. ....	126
Dunkle, H. H. ....	398	Sefing, F. G. ....	782
E		Siebert, Clarence A. ....	187
Ellinger, G. A. ....	495	Sykes, W. P. ....	249
F		T	
Franks, Russell ....	968	Trigger, K. J. ....	782
G		U	
Gilbert, W. W. ....	703	Upthegrove, Clair ....	187
Goss, N. P. ....	511, 621	Urban, Stephen F. ....	93, 645
Graff, Howard F. ....	249	V	
Greene, O. V. ....	861	van Wert, Leland Russell ....	633
H		W	
Herty, Jr., C. H. ....	113	Walters, Jr., F. M. ....	727, 751
Hoyt, S. L. ....	61, 1022	Weinland, Clarence E. ....	431
I		Weldon, M. J. ....	886
Isenburger, Herbert R. ....	614	Wells, Cyril ....	727, 751
J		White, A. E. ....	995
Jordan, Louis ....	577, 839	Wills, W. H. ....	469
K		Wilson, R. L. ....	995
Knight, O. A. ....	693	Wilten, H. M. ....	915
Krivobok, V. N. ....	1	Wood, T. J. ....	455
L		Y	
Lee, E. F. ....	382	Yensen, T. D. ....	556
Liedholm, C. A. ....	672	Z	
Luerssen, G. V. ....	861	Ziegler, N. A. ....	556



## AMERICAN SOCIETY *for* METALS

### FOUNDER MEMBERS

THEODORE E. BARKER	*ARTHUR G. HENRY	WILLIAM P. WOODSIDE
Chicago		Detroit

### HONORARY MEMBERS

*CHARLES F. BRUSH, SC. D.	.....
*EDWARD DEMILLE CAMPBELL	.....
HENRY LE CHATELIER	.....Paris, France
*JUDGE ELBERT H. GARY	.....
SIR ROBERT HADFIELD, BART, F. R. S.	.....London, England
*ELWOOD HAYNES	.....
KOTARO HONDA, SC. D.	.....Sendai, Japan
*HENRY MARION HOWE, SC. D.	.....
CHARLES F. KETTERING	.....Detroit
*JOHN ALEXANDER MATHEWS, SC. D.	.....
ALBERT SAUVEUR, SC. D.	.....Cambridge, Mass.
CHARLES M. SCHWAB	.....New York City
WILLIS R. WHITNEY, Ph. D.	.....Schenectady
*THOMAS ALVA EDISON, SC. D.	.....

### HENRY MARION HOWE MEDALISTS

EMANUEL J. JANITZKY	.....1922
FRANCIS F. LUCAS	.....1924
HORACE H. LESTER	.....1925
FREDERICK C. LANGENBERG	.....1926
WESLEY P. SYKES	.....1927
OSCAR E. HARDER and RALPH L. DOWDELL	.....1928
CARL R. WOHRMAN	.....1929
H. J. FRENCH	.....1930
E. C. BAIN and K. HEINDLHOFFER	.....1931
FRANCIS M. WALTERS, CYRIL WELLS, M. GENSAMER and JOHN F. ECKEL	1932
JOSEPH V. EMMONS	.....1933
JOHN CHIPMAN	.....1934
T. D. YENSEN and N. A. ZIEGLER	.....1935

### SAUVEUR ACHIEVEMENT MEDAL

ALBERT SAUVEUR	.....1934
ZAY JEFFRIES	.....1935

\*Deceased

# AMERICAN SOCIETY *for* METALS

## Standing Committees

### FINANCE COMMITTEE

W. P. WOODSIDE, Chairman  
Climax Molybdenum Corp.  
Detroit

Members:\*

Zay Jeffries, Cleveland, '38  
W. S. Bidle, Cleveland, '38  
Walter Mathesius, Chicago, '36  
Paul D. Merica, New York, '36

### CONSTITUTION AND BY-LAWS COMMITTEE

GEORGE R. LONG, Chairman '36  
Frigidaire Corp.  
Dayton, Ohio

Members:

L. F. Fitzpatrick, Toronto, '37  
L. D. Hawkrigge, Boston, '38  
George J. O'Neill, York, '37  
S. C. Spalding, Waterbury, (Ex-officio)  
Clyde Williams, Columbus, '36

### PUBLICATION COMMITTEE

W. P. SYKES, Chairman '36  
General Electric Co.  
Cleveland

RAY T. BAYLESS, Secy.  
7016 Euclid Ave.  
Cleveland

Members:

H. E. Ardahl, Tri-City, '37  
A. A. Bates, Cleveland, '38  
C. L. Clark, Detroit, '36  
E. S. Davenport, New Jersey, '37  
C. N. Dawe, Detroit, '38  
M. A. Grossmann, Chicago, '37  
W. E. Harvey, Lehigh Valley, '37  
Louis Jordan, Washington, '36  
G. V. Luerksen, Lehigh Valley, '36  
D. F. McFarland, Penn State, '37  
O. W. McMullan, New Jersey, '38  
R. F. Mehl, Boston, '36  
N. I. Stotz, Pittsburgh, '38  
Joseph Winlock, Philadelphia, '37

### METALS HANDBOOK COMMITTEE

C. H. HERTY, JR., Chairman '36  
Bethlehem Steel Co.  
Bethlehem

J. EDWARD DONNELLAN, Secy.  
7016 Euclid Avenue  
Cleveland

Members:

W. C. Chancellor, Cleveland, '37  
R. L. Dowdell, Northwest, '38  
J. P. Gill, Pittsburgh, '36  
S. L. Hoyt, Milwaukee, '38  
G. C. Riegel, Peoria, '37  
Adam Steever, Chicago, '37  
Jerome Strauss, Pittsburgh, A.I.M.E. Rep.

## Sub-Committees

### FORGING ALLOY STEELS

W. E. JOMINY, Chairman  
General Motors Corp.  
Detroit

Members:

H. M. Spears      A. M. Steever

### GAS CARBURIZING

H. W. McQUAID, Chairman  
Republic Steel Corp.  
Detroit

Members:

R. G. Guthrie      P. C. Osterman  
H. E. Koch      E. A. Thomas

### HARDNESS TESTING OF METALS

H. M. GERMAN, Chairman  
Driver-Harris Co.  
Harrison, New Jersey

Members:

C. H. Bierbaum      I. H. Cowdrey  
O. W. Boston      A. L. Davis  
R. C. Brumfield      S. L. Goodale

### HEAT TREATING—GENERAL

R. S. ARCHER, Chairman  
Republic Steel Corp.  
Chicago

Members:

J. P. Gill      G. C. Lilly  
W. G. Hildorf      W. B. Price  
C. T. Willard

### HEAT RESISTING ALLOYS

O. E. HARDER, Chairman  
Battelle Memorial Institute  
Columbus, Ohio

Members:

E. C. Bain      T. H. Nelson  
F. M. Becket      N. B. Pilling  
F. A. Fahrenwald      L. J. Stanbery  
H. H. Harris      E. H. Stilwell  
M. A. Hunter      W. B. Sullivan  
C. M. Johnson      R. D. Van Nordstrand  
F. K. Ziegler

\*The numerals following each committeeman's name indicate that his term of office on that committee expires at the close of the annual meeting of the Society of the year expressed.

## MACHINABILITY OF STEEL

O. W. BOSTON, Chairman  
University of Michigan  
Ann Arbor, Michigan

A. L. Boegehold

Members:

H. J. French

## MACRO ETCHING

H. G. KESHIAN, Chairman  
Chase Companies, Inc.  
Waterbury, Conn.

J. J. Curran  
M. W. Dalrymple  
J. P. Gill  
J. L. Holmquist

Members:

J. P. Howley  
L. A. Lanning  
G. V. Luerssen  
W. R. Shimer

M. G. Yatskevitch

## HEAT TREATMENT OF TOOL STEEL

A. D. BEEKEN, JR., Chairman  
Vulcan Crucible Steel Co.  
Aliquippa, Pa.

H. T. Cousins  
J. E. Erb  
Burns George  
J. P. Gill  
I. F. Holland  
A. S. Jameson  
C. M. Johnson  
W. J. Merten

Members:

F. R. Palmer  
W. H. Phillips  
DuRay Smith  
S. C. Spalding  
N. I. Stotz  
J. A. Succop  
W. H. Wills  
George H. Wright

## NON-FERROUS DATA SHEET COMMITTEE OF INSTITUTE OF METALS DIVISION

JEROME STRAUSS, Chairman  
Vanadium Corporation of America  
Bridgeville, Pa.

L. W. Kempf  
N. B. Pilling

Members:

E. E. Schumacher  
W. E. Reemers

## PHYSICAL CONSTANTS OF METALS

REID L. KENYON, Chairman  
American Rolling Mill Co.  
Middletown, Ohio

Dr. H. W. Russell

Members:

J. B. Johnson

## AGING OF IRON AND STEEL

SAMUEL EPSTEIN, Chairman  
Battelle Memorial Institute  
Columbus, Ohio

Member:

H. L. Miller

## CHROMIUM PLATING OF TOOLS

D. A. NEMSER, Chairman  
International Nickel Co., Inc.  
Hartford, Conn.

Member:

W. E. Bancroft

## MAGNETIC TESTING

JAMES ALLISON, Chairman  
Union Drawn Steel Co.  
Hartford, Conn.

C. T. Hewitt

Members:

H. J. Noble

## WROUGHT IRON

A. W. F. GREEN, Chairman  
Ludlum Steel Co.  
Watervliet, N. Y.

## HARDNESS CONVERSION

R. R. MOORE, Chairman  
277 Lafayette Avenue  
Grantwood, N. J.

Member:

I. H. Cowdrey

## PYROMETRY

KIRTLAND MARSH, Chairman  
Aluminum Company of America  
Pittsburgh

Richard P. Brown  
F. A. Faust

Members:

S. C. Horn  
W. T. Morgan  
C. O. Fairchild

## JOINT COMMITTEE ON DEFINITIONS OF HEAT TREATING TERMS

A.S.M. Representatives:

J. Fletcher Harper

W. J. Merten

Bradley Stoughton

## Chapters and Officers

### BALTIMORE CHAPTER

J. F. HAKES, Chairman,  
Baltimore Tool Co.,  
Baltimore.

PAUL LANE, Secy.-Treas.,  
American Hammered Piston Ring Co.,  
Baltimore.

### BOSTON CHAPTER

W. P. KNECHT, Chairman,  
Crucible Steel Co. of America,  
540 Atlantic Ave.,  
Boston.

H. E. HANDY, Secy.-Treas.,  
Saco-Lowell Shops,  
Biddeford, Maine.

### BUFFALO CHAPTER

F. L. WEAVER, Chairman,  
722 United Artists Bldg.,  
Detroit.

B. L. MCCARTHY, Secretary,  
Wickwire Spencer Steel Co.,  
River Road,  
Buffalo, N. Y.

G. F. ROEDER, Treasurer,  
J. T. Ryerson & Sons, Inc.,  
Buffalo, N. Y.

### CANTON-MASSILLON CHAPTER

T. J. BLACK, Chairman,  
40th St., N. W.,  
R. F. D. 2,  
Canton, Ohio.

W. J. BUECHLING, Secretary,  
Republic Steel Corp.,  
Canton, Ohio.

J. D. ARMOUR, Treasurer,  
Union Drawn Steel Co.,  
Massillon, Ohio.

### CHICAGO CHAPTER

H. B. KNOWLTON, Chairman,  
International Harvester Co.,  
2600 West 31st Blvd.,  
Chicago.

K. H. HOBBIE, Secy.-Treas.,  
Driver-Harris Co.,  
1140 W. Washington Blvd.,  
Chicago.

### CINCINNATI CHAPTER

WALTER ARCHEA, Chairman,  
6621 Iris Ave.,  
Cincinnati, Ohio.

KURT SIEMS, Secy.-Treas.,  
Cincinnati Milling Machine Co.,  
Oakley, Cincinnati, Ohio.

### CLEVELAND CHAPTER

H. B. PULSIFER, Chairman,  
American Steel & Wire Co.,  
8101 Broadway,  
Cleveland.

GORDON WILLIAMS, Secy.-Treas.,  
Cleveland Tractor Co.,  
19300 Euclid Ave.,  
Cleveland.

### COLUMBUS CHAPTER

R. H. FRANK, Chairman,  
Bonney-Floyd Co.,  
Columbus, Ohio.

L. H. MARSHALL, Secretary,  
3629 Weston Pl.,  
Columbus, Ohio.

J. C. SMITH, Treasurer,  
Bonney-Floyd Co.,  
Columbus, Ohio.

### DAYTON CHAPTER

S. K. OLIVER, Chairman,  
Delco Products Corp.,  
Dayton, Ohio.

F. M. REITER, Secretary,  
Executive Offices,  
Dayton Power and Light Co.,  
Dayton, Ohio.

R. W. WEBER, Treasurer,  
National Cash Register Co.,  
Research Dept.,  
Dayton, Ohio.

### DETROIT CHAPTER

GLENN COLEY, Chairman,  
Detroit Edison Co.,  
Detroit.

E. B. DRAKE, Secy.-Treas.,  
Wayne University,  
Detroit.

### GOLDEN GATE CHAPTER

LEO M. MARTIN, Chairman,  
1035 Folsom St.,  
San Francisco

R. S. HIRST, Secy.-Treas.,  
2142 Ward St.,  
Berkeley, Calif.

### HARTFORD CHAPTER

J. P. HOWLEY, Chairman,  
Pratt and Whitney Co.,  
Hartford, Conn.

H. J. NOBLE, Secy.-Treas.,  
Pratt and Whitney Aircraft Co.,  
E. Hartford, Conn.

### INDIANAPOLIS CHAPTER

R. L. FITZSIMMONS, Chairman,  
1342 N. Grant Ave.,  
Indianapolis.

R. A. THOMPSON, Secretary,  
Electric Steel Castings Co.,  
Speedway, Indianapolis.

AXEL WEYDELL, Treasurer,  
1545 North Gale St.,  
Indianapolis.

### LEHIGH VALLEY CHAPTER

A. C. JONES, Chairman,  
Lebanon Steel Company,  
Lebanon, Pa.

LEON SCHEIFELE, Secy.-Treas.,  
2418 Kutztown Road,  
Reading, Pa.

### LOS ANGELES CHAPTER

C. E. BURT, Chairman,  
5919 Haas Ave.,  
Los Angeles.

S. R. KIMBERLY, Secy.-Treas.,  
Los Angeles Steel Casting Co., Ltd.,  
2444 S. Alameda St.,  
Los Angeles.



## Chapters and Officers (Continued)

### MILWAUKEE CHAPTER

D. C. ZUEGE, Chairman,  
Sivyer Steel Castings Co.,  
Milwaukee.

W. J. SPARLING, Secy.-Treas.,  
Chain Belt Co.,  
Milwaukee.

### MONTREAL CHAPTER

C. M. CARMICHAEL, Chairman,  
Shawinigan Stain. Steel and Alloys  
Power Bldg., Craig St.,  
Montreal, P. Q., Canada.

MISS B. W. BROWNRIGG, Secretary,  
P. O. Box 371—Station 'H'  
Montreal, P. Q., Canada.

A. T. SARGENT, Treasurer,  
4581 Hingston Ave.,  
Montreal, P. Q., Canada.

### MUNCIE CHAPTER

F. W. CARL, Chairman,  
2915 Columbus Ave.,  
Anderson, Ind.

L. W. MURRAY, Secy.-Treas.,  
Delco Remy Corp.,  
Anderson, Ind.

### NEW HAVEN CHAPTER

P. L. CLARK, Chairman,  
Bridgeport Brass Co.,  
Bridgeport, Conn.

J. F. SARGENT, Secy.-Treas.,  
R. Wallace & Sons Mfg. Co.,  
Wallingford, Conn.

### NEW JERSEY CHAPTER

F. A. ELSHOFF, Chairman,  
Crocker-Wheeler Electric Mfg. Co.,  
Ampere, N. J.

J. H. JOHNSON, Secretary,  
2 William St.,  
Scotch Plains, N. J.

R. W. THORNE, Treasurer,  
95 Hatfield St.,  
Caldwell, N. J.

### NEW YORK CHAPTER

H. C. BOSTWICK, Chairman,  
35 Spruce St.,  
Cranford, N. J.

T. N. HOLDEN, Secy.-Treas.,  
1219 Glenwood Rd.,  
Brooklyn, N. Y.

### NORTHWEST CHAPTER

D. E. HULT, Chairman,  
Auto Engine Works, Inc.,  
349 N. Hamline Ave.,  
St. Paul, Minn.

ALEXIS CASWELL, Secy.-Treas.,  
405 Marquette Ave.,  
Minneapolis.

### NOTRE DAME GROUP

J. A. KINGSBURY, Chairman,  
Bendix Prod. Corp.,  
Research Dept.,  
South Bend, Ind.

W. C. TROY, Secretary,  
9 Corby Hall,  
University of Notre Dame,  
Notre Dame, Ind.

G. J. FOSS, Treasurer,  
University of Notre Dame,  
Notre Dame, Ind.

### ONTARIO CHAPTER

A. ORAM, Chairman,  
Burlington Steel Co.,  
Hamilton, Ont., Canada.

L. F. FITZPATRICK, Secretary,  
Flexible Shaft Co., Ltd.,  
Toronto, Ont., Canada.

J. R. GORDON, Treasurer,  
Ontario Research Foundation,  
Toronto, Ont., Canada.

### PENN STATE GROUP

C. A. BEERS, Chairman,  
250 S. Burrowes St.,  
State College, Pa.

D. F. McFARLAND, Corresponding Secretary,  
Pennsylvania State College,  
State College, Pa.

L. A. RODECKER, Recording Secretary,  
520 W. Beaver Ave.,  
State College, Pa.

### PEORIA CHAPTER

C. C. RIEGEL, Chairman,  
Caterpillar Tractor Co.,  
Peoria, Ill.

J. W. BRIDWELL, Secretary,  
111 Barker Ave.,  
Peoria, Ill.

M. W. WATSON, Treasurer,  
108 E. Gift,  
Peoria, Ill.

### PHILADELPHIA CHAPTER

G. W. KELLER, Chairman,  
720 Chelton Ave.,  
Oak Lane,  
Philadelphia.

A. O. SCHAEFER, Secy.-Treas.,  
310 West Durham St.,  
Mt. Airy,  
Philadelphia.

### PITTSBURGH CHAPTER

A. D. BEEKEN, JR., Chairman,  
Vulcan Crucible Steel Co.,  
Aliquippa, Pa.

H. L. WALKER, Secy.-Treas.,  
Box 6621, N. S. Sta.,  
Pittsburgh.

### RHODE ISLAND CHAPTER

C. R. BROADHEAD, Chairman,  
Narragansett Electric Co.,  
Turks Head Bldg.,  
Providence, R. I.

C. G. PETERSON, Secy.-Treas.,  
Providence Gas Co.,  
Providence, R. I.

### ROCHESTER CHAPTER

L. J. SULLIVAN, Chairman,  
Rochester Gas and Electric Corp.,  
Rochester, N. Y.

I. C. MATTHEWS, Secy.-Treas.,  
Eastman Kodak Co.,  
Rochester, N. Y.



### Chapters and Officers (Continued)

#### ROCKFORD CHAPTER

FREEMAN ANDERSON, Chairman,  
National Lock Co.,  
Rockford, Ill.

ALAN MATTISON, Secy.-Treas.,  
Mattison Machine Works,  
Rockford, Ill.

#### SCHENECTADY CHAPTER

L. L. WYMAN, Chairman,  
General Electric Co.,  
Schenectady, N. Y.

LYALL ZICKRICK, Secy.-Treas.,  
General Electric Co.,  
Research Laboratories,  
Schenectady, N. Y.

#### SOUTHERN TIER CHAPTER

W. S. BENNETT, Chairman,  
Elmira Water Light and R. R. Co.,  
Elmira, N. Y.

K. J. MACKENZIE, Secretary,  
International Business Machines Corp.,  
Endicott, N. Y.

W. J. SQUIRE, Treasurer,  
Eclipse Machine Co.,  
Elmira, N. Y.

#### SPRINGFIELD CHAPTER

R. S. ROSE, Chairman,  
Vanadium-Alloys Steel Co.,  
Springfield, Mass.

A. W. MORRIS, Secy.-Treas.,  
54 Buckingham St.,  
Springfield, Mass.

#### ST. LOUIS CHAPTER

C. M. STEVENSON, Chairman,  
Vanadium-Alloys Steel Co.,  
St. Louis, Mo.

G. J. MOELLER, Secy.-Treas.,  
Ramsey Accessories Mfg. Corp.,  
St. Louis, Mo.

#### SYRACUSE CHAPTER

C. H. PARMELEE, Chairman,  
Onondaga Pottery,  
Syracuse, N. Y.

ROBERT WARREN, Secy.-Treas.,  
Crucible Steel Co.,  
104 Magnolia St.,  
Syracuse, N. Y.

#### TRI-CITY CHAPTER

CAPT. L. S. FLETCHER, Chairman,  
Rock Island Arsenal,  
Rock Island, Ill.

R. H. LIND, Secy.-Treas.,  
Peoples Light Co.,  
Davenport, Iowa.

#### WASHINGTON CHAPTER

S. J. ROSENBERG, Chairman,  
Bureau of Standards,  
Washington, D. C.

E. F. WILSON, Secy.-Treas.,  
Metallurgical & Testing Division,  
U. S. Naval Gun Factory,  
Washington, D. C.

#### WORCESTER CHAPTER

A. BRADFORD REED, Chairman,  
Rolled Thread Die Co.,  
237 Chandler St.,  
Worcester, Mass.

G. A. PETERSON, Secy.-Treas.,  
Pratt and Inman  
12 Cherry St.,  
Worcester, Mass.

#### YORK CHAPTER

FRANK ALLEN, Chairman,  
33 N. Rockburn St.,  
York, Pa.

C. M. STRICKLER, Secy.-Treas.,  
General Machine Works,  
York, Pa.